SECTION 3

AASHTO DESIGN SPECIFICATIONS, NJDOT MODIFICATIONS

1.3.1 VEHICULAR BRIDGES

The current Edition of the AASHTO Standard Specifications for Highway Bridges (with current Interims) and the following modifications, to the respective AASHTO sections, shall govern the design:

(NOTE: All references to the document listed above will hereinafter be referred to as the AASHTO Standard Specifications for Highway Bridges. The following Section numbers refer to the AASHTO Division 1 section number designations.)

SECTION 2 - GENERAL FEATURES OF DESIGN

2.2.5 CURBS AND SIDEWALKS

When curb and gutter sections are used on the roadway approaches to a bridge, the curb height on the bridge shall match the curb height on the roadway approach.

2.2, 2.3 HIGHWAY CLEARANCES FOR BRIDGES
2.4, 2.5

Lateral clearances shall conform to Section 5-11 of the NJDOT Design Manual - Roadway. Bridge sketch plans (See Section 6 of this Manual) shall be submitted on a project to project basis.

Minimum vertical underclearances shall be in accordance with the Table on the following page.

2.7.1 Vehicular Railing

The provision of the bridge railing systems, that are illustrated in Subsection 1.23.2 of this Manual, shall be accounted for in providing crash tested vehicular railings on New Jersey bridge structures.

MINIMUM VERTICAL UNDERCLEARANCES FOR BRIDGES AND STRUCTURES

	Vehicular and Railroad Over Crossings	Pedestrian and Bikeway Over Crossings	Overhead Sign Structures	Tunnels	Remarks
Interstates Freeways Expressways	5.05 m	5.25 m	5.4 m	5.05 m	Notes 1, 7
Rural Arterials	5.05 m	5.25 m	5.4 m	5.05 m	Notes 2, 7
Urban Arterials *	5.05 m	5.25 m	5.4 m	5.05 m	Notes 2, 7
Local Roads and Streets and Collector Roads and Streets (Rural)	4.45 m	4.75 m	5.4 m	4.45 m	
Railroads	7.01 m	7.01 m	--	7.01 m	Note 3
Electrical Tracks	7.47 m	7.47 m	--	7.47 m	Note 3
Inter-Coastal Waterway	16.76 m	--	--	--	Note 4
Navigable Waterways	Varies	--	--	--	Note 5
Other Waterways	Varies	--	--	--	Note 6
Existing Bridges and Structures	--	--	--	--	Note 8

* In highly urbanized areas, a minimum clearance of 4.45 m may be provided if there is one route, within the approximate location of the bridge in question, that provides an existing 5.05 m minimum clearance.

NOTES

1. Exceptions to this standard are the portions of existing Interstate routes where existing controls make the 5.05 meters standard impractical or when, due to unusual conditions,

the cost of the higher standard becomes excessive. In such cases, any variations in the vertical clearances shall be as approved by the Federal Highway Administration and as recommended by the Manager, Bureau of Structural Engineering. The request to the Federal Highway Administration shall be signed by the Director, Division of Design Services.

2. Exceptions to this standard are the portions of existing State Highway System routes where existing controls make the 5.05 meters standard impractical or when, due to unusual conditions, the cost of the higher standard becomes excessive. In such cases, any variations in the vertical clearances shall be as approved by the Director, Division of Design Services and as recommended by the Manager, Bureau of Structural Engineering. Such request shall be signed by the NJDOT Project Manager.

3. The 7.01 meters for a vertical clearance above the top of rails (7.47 meters for electrified tracks) includes an allowance of 300 millimeters for future ballasting of the railroad tracks and minor structure encroachment during construction or maintenance operations and still provides clearance in compliance with AREA standards. Changes to the standard vertical clearances may be approved when ordered by the State regulatory agency having jurisdiction over such matters. Greater vertical clearance may be required at individual locations where necessary and when justified on the basis of extraordinary site conditions.

4. Changes to the standard 16.76 meters clearance (above M.H.W.) may be approved if justified by marine traffic and cost studies or ordered by the U.S. Coast Guard.

5. Clearance contingent on marine traffic and cost studies. Clearance subject to approval by the U.S. Coast Guard.

6. Freeboard clearance contingent on hydraulic and hydrologic studies. Subject to approval by N.J. Division of Water Resources.

7. The clearance shall apply over the entire roadway width including any contiguous auxiliary lanes and shoulders.

8. State Laws, N.J.S.A. 27:5G-1 through 27:5G-4, require that every bridge or overpass carrying municipal, county, or state roads, including railroads, with a vertical clearance of less than 4.4196 meters from the roadway beneath shall have a minimum clearance marked or posted thereon in accordance with the current standards prescribed by the "Manual of Uniform Traffic Control Devices for Streets and Highways".

   Signs warning persons operating motor vehicles that they are approaching a bridge or overpass with less than 4.4196 meters clearance shall be placed at the last safe exit or detour preceding the bridge or overpass. The minimum clearance of the bridge or overpass shall be indicated on these signs.
   The signs required by this section shall be maintained by the appropriate government entity which has jurisdiction over the roadway underneath the bridge or overpass. The above provisions do not apply to toll road authorities.

GENERAL

If it is anticipated that future lanes will be required for the lower roadway, the clearance stipulated in this policy shall be applied to the future lane.

The clearance for ramps shall be that of the connecting highway. In the case where a ramp connects highways with different vertical clearance criteria, the higher clearance shall be used.

Clearances stipulated in this policy include a 150 millimeters allowance for resurfacing.

For spans between 36.6 meters and 45.7 meters, the need for bolted splice (located near one quarter-point) should be anticipated in calculating the minimum vertical clearance. An allowance of 20 millimeters (fastener head) plus thickness of bottom flange splice plate shall be considered.

For spans over 45.72 meters, two splices located near each quarter-point should be anticipated. An allowance of 19.5 millimeters (fastener head) plus thickness of bottom flange splice plate shall be considered.

SECTION 3-LOADS

3.3 DEAD LOAD

Superstructure design for bridges which utilize One-Course deck slab construction shall include a 1.2 kPa additional dead load to provide for a future 50 millimeter thick concrete overlay protective system. The 1.2 kPa shall be considered as a secondary dead load.

Bridges with Two-Course slab construction, shall ***not*** include the 1.2 kPa additional dead load for superstructure design.

The top 13 millimeters of the concrete deck slab thickness shall be considered as a wearing surface. Consequently, it shall be considered as dead load, but shall not be considered effective in carrying secondary dead loads (except future overlay wearing surface) or live loads and impact. Also see 1.20.1(h) of this Manual for Two-Course deck slab design.

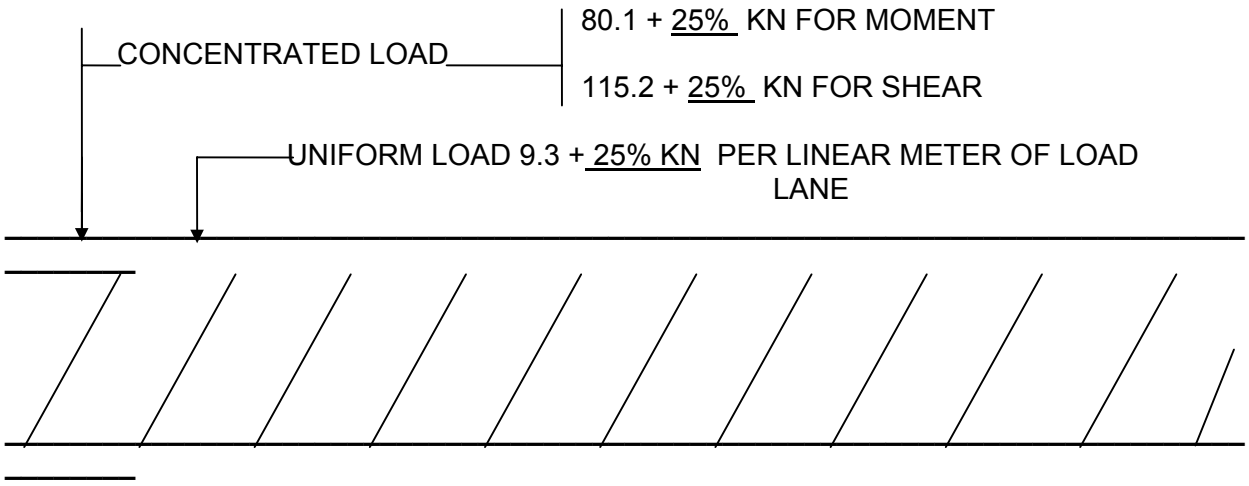
Also see Article 10.14 - Camber, as modified elsewhere herein, for metal Stay-In-Place forms and additional thickness of deck concrete.

Design calculations for slab thickness and reinforcement steel areas shall be made assuming removable forms.

3.7 HIGHWAY LOADS

3.7.2 CLASSES OF LOADING

The following Class illustration shall be added to AASHTO Figure 3.7.6 B:



MS 18+25% (MS 22.5)

Add the following STANDARD MS TRUCK to AASHTO Figure 3.7.7 A:

MS 18 +25% (MS 22.5) SEE GUIDE PLATE 3.17-1.
Forces shown for MS 18 loading shall be proportionately increased by 25%.

Loading MS 18 +25% (MS 22.5) is 125 percent of loading MS 18.

3.7.3 DESIGNATION OF LOADINGS

The increased design loading shall be designated MS 18 +25% (MS 22.5).

3.7.4 MINIMUM LOADING

The minimum live load on bridges supporting interstate highways and other bridges shall be the MS 18 +25% (MS 22.5) designated herein or an Alternative Military Loading of two axles 1.2 meters apart with 108 kilonewtons per axle whichever loading produces the greatest stress.

The minimum optional live loading on Non-Federal Aid Highway, (off-system) bridges with projected ADTT to 500 shall be the MS 18 +10% (MS 19.8) (see Guide Plate 3.17-2) or the alternate military loading described above.

3.16 THERMAL FORCES

In determining stresses for rigid frame piers on typical highway grade crossings on continuous footings, the temperature differential shall be 8 EC for rise in temperature and 11 EC for fall in temperature.

The temperature values established for "cold climate" shall be used for all other cases.

3.20 EARTH PRESSURE

3.20.1

". . . no structure shall be designed for less than equivalent fluid pressure of 5.5 kilonewtons per cubic meter . . ."

3.21 EARTHQUAKES

Seismic loading shall be in accordance with Section 45 of this Manual, Seismic Design and Retrofit.

3.24 DISTRIBUTION OF LOADS AND DESIGN OF CONCRETE SLABS

3.24.3 BENDING MOMENT

Add another line at the end of paragraph 2:

P18 +25% = 89 kilonewtons for M18 +25% loading.

Add the following at end of MS13.5 loading formula for Case A method:

MS 18 +25% (MS 22.5) loading:
Use 1.25 times the values obtained from the formulas for MS 18 loading.

Add the following at end of MS 13.5 loading formula for Case A method:

MS 18 + 25% (MS 22.5) loading:

Use 1.25 times the values obtained from the formulas for MS 18 loading.

3.24.8 LONGITUDINAL EDGE BEAMS

3.24.8.2

Revise value of P in second paragraph as follows:

P = Wheel load, in kilonewtons P18 +25%.

3.25 DISTRIBUTION OF WHEEL LOADS ON TIMBER FLOORING

3.25.1 TRANSVERSE FLOORING

3.25.1.3

Add K (design constant) for MS 18 +25% (MS 22.5) in maximum moment formula:

MS 18 +25% (MS 22.5) = 0.55

3.29 MOMENTS, SHEARS AND REACTIONS

All values in the Table for MS 18 Loading in Appendix A shall be proportionately increased 25% to conform to the above designated truck and lane load.

SECTION 4 - FOUNDATIONS and
SECTION 5 - RETAINING WALLS

5.8.1 STRUCTURE DIMENSIONS

Criterion for ultimate bearing capacity shall be in accordance with Article 4.4.7 for footings on soil and Article 4.4.8 for footings on rock.

5.8.3 BEARING CAPACITY AND FOUNDATION STABILITY

Criterion for ultimate bearing capacity shall be in accordance with Article 4.4.7 for footings on soil and Article 4.4.8 for footings on rock.

5.8.4.2 EXTENSIBLE REINFORCEMENTS

The use of extensible reinforcements for MSE walls is not permitted.

Refer to Section 16 of this Manual for additional Design Criteria.

SECTION 8 - REINFORCED CONCRETE

8.14.1 DESIGN METHODS

8.14.1.1

The design of reinforced concrete members shall be made with reference to service loads and allowable stresses provided in SERVICE LOAD DESIGN.

The use of the LRFD Bridge Design Specifications is permitted. The Manager, Structural Engineering shall concur to the use of these specifications.

8.15.2 ALLOWABLE STRESSES

8.15.2.1.1 FLEXURE

Extreme fiber in compression, deck slabs of vehicular bridges only..... fc = 9.8 MPa.

8.15.2.2 REINFORCEMENT

Grade 420 Reinforcement.....165 MPa

8.18 REINFORCEMENT OF COMPRESSION MEMBERS

Reinforcement in the compression face of deck slab shall not be considered in the design.

8.20 SHRINKAGE AND TEMPERATURE REINFORCEMENT

Deck slab top layer temperature - distribution steel shall be #16 @ 375 millimeters.

8.22 PROTECTION AGAINST CORROSION

8.22.1

Top reinforcement cover shall be 65 millimeters for One-Course bridge deck slabs. Top reinforcement cover shall be 40 millimeters in the first course for Two-Course deck slabs.

Reinforcement cover shall be 65 millimeters for overlay deck slabs on prestressed concrete slab or box beams.

Also refer to Subsection 1.20.2 of this Manual.

8.32 SPLICES OF REINFORCEMENT

The length of lap shall be designed based on the use of Grade 420 bars. The dimensions of all laps shall be shown on the Contract Plans.

SECTION 9 - PRESTRESSED CONCRETE

9.13 GENERAL

9.13.1 DESIGN THEORY AND GENERAL CONSIDERATIONS

9.13.1.2

Allowable Stress Design (Service Load Design Method) shall be used as the standard design method for all structure types. The ultimate moment capacity of the beam section shall be checked by the Strength Design Method (Load Factor Design Method) and be checked against the calculated cracking moment in accordance with Article 9.18.2. This moment capacity must be 1.2 times cracking moment of section to insure ductile failure.

The use of the LRFD Bridge Design Specifications is permitted. The Manager, Structural Engineering shall concur to the use of these specifications.
Low relaxation strands, as called for on the Standard Drawing Plates, shall be used and accounted for in the design of prestressed concrete beams.

Prestressing of strands shall be accomplished by pretensioning. The strands may be debonded or harped (draped).

9.15 ALLOWABLE STRESSES

Generally the design strength for prestressed concrete shall be f'c = 35 megapascals (MPa) (Class P concrete). The stress transfer shall not be made to the bridge members until the test specimens indicate that the concrete has reached a compressive strength of at least 28 MPa. The Engineer may use an optional, higher design strength of 38 MPa (Class P1 concrete) or 42 MPa (Class P2 concrete). For these cases, the respective specified concrete release strength shall be 31 MPa or 34 MPa.

9.15.2.2 STRESS AT SERVICE LOAD AFTER LOSSES HAVE OCCURRED.

Tension in the precompressed tensile zone shall be zero.

9.28 EMBEDMENT OF PRESTRESSED STRAND

9.28.1

The development length for all strand sizes up to and including 15 millimeters shall be determined as 1.6 times the AASHTO equation 9-32.

SECTION 10 - STRUCTURAL STEEL

10.3 REPETITIVE LOADING AND TOUGHNESS CONSIDERATIONS

10.3.2 LOAD CYCLES

10.3.2.1

The number of cycles of maximum stress range to be considered in the design shall be Case I from Table 10.3.2A for all vehicular bridges regardless of Type of Road. Any exceptions shall be subject to approval prior to the Preliminary Plan Submission.

10.3.3 CHARPY V-NOTCH IMPACT REQUIREMENTS

Section 917.10 of the NJDOT 1996 Standard Specifications for Road and Bridge Construction designates Zone 2 temperatures.

10.6 DEFLECTION

10.6.2

Members having simple or continuous spans shall be designed so that the deflection due to service live load plus impact shall not exceed 1/1000 of the span length.

The span length shall be considered as the distance center to center of bearing for simple spans.

For continuous spans, the span length shall be considered as the distance between the dead load points of contraflexure.

10.6.3

The deflection of cantilever arms due to service live load plus impact shall be limited to 1/400 of the cantilever arm.

The live load deflection for pedestrian bridges shall be limited to 1/800 of the span length.

10.8 MINIMUM THICKNESS OF METAL

Structural steel . . . shall be not less than 10 millimeters in thickness. (See Article 10.34.3 elsewhere herein for minimum web thickness of welded plate girders).

10.13 COVER PLATES

Welded cover plates shall be narrower than the flange to which they are attached. Research indicates that when cover plates are wider than the flange, fatigue strength is significantly reduced. If fatigue strength is reduced edge cracks may occur in the flange.

10.14 CAMBER

An additional 0.4 kPa shall be included in the camber computations to account for the dead load of permanent stay-in-place forms and 0.2 kPa shall be included to account for the average 10 millimeters additional thickness of deck concrete which fills the forms.

Reference Subsection 1.20.3 f. for additional concrete dead load which might be required if it is anticipated that the stay-in-place forms will be dropped to achieve minimum 25 millimeters concrete cover for curved or skewed bridge decks.

10.23 WELDING

10.23.1 GENERAL

Welding shall conform to the requirements of the ANSI/AASHTO/AWS Bridge Welding Code D1.5, except that Electro-slag weldments on main structural tension members will not be permitted.

10.29 FIXED AND EXPANSION BEARINGS

10.29.1.3

In lieu of the above requirements refer to Subsection 1.24.19 of this Manual for additional guidance.

PART C - SERVICE LOAD DESIGN METHOD (ALLOWABLE STRESS DESIGN)

10.31 SCOPE

Allowable stress design shall be used as the standard design method for all structure types.

The use of the LRFD Bridge Design Specifications is permitted. The Manager, Structural Engineering shall concur to the use of these specifications.

10.34 PLATE GIRDERS

10.34.3 THICKNESS OF WEB PLATES

Minimum web thickness shall be 11 millimeters.

10.34.4 TRANSVERSE INTERMEDIATE STIFFENERS

Design should minimize the number of intermediate stiffeners to the extent practical. See Subsection 1.24.4(a) of this Manual for commentary.

See Guide Sheet Plates 3.9-18 to 3.9-20 of this Manual for treatment of ends of stiffeners at compression and tension flanges.

Connection plates for utilities and other appurtenances should be bolted when it is necessary to secure them to main component members of the girders which are in tension.

10.34.5 LONGITUDINAL STIFFENERS

The use of longitudinal stiffeners shall be limited to spans greater than 61 meters.

The following note shall be added to Plans whenever a longitudinal stiffener is used:

A maximum of 2 splices will be permitted for longitudinal stiffeners. Under the requirements for Quality Control Inspection, prior to welding the stiffener to the stringer, the butt welds shall be radiographed,

10.38 COMPOSITE GIRDERS

10.38.2 SHEAR CONNECTORS

Welded Studs shall be used for shear connectors. See Guide Plate 3.9-8 of this Manual.

10.38.4 STRESSES

In continuous spans, the positive moment portion shall be designed with composite sections as in simple spans. The negative moment portion shall be designed as a non-composite section; however, shear connectors shall be provided at a nominal pitch of 600 millimeters to 900 millimeters.

Additional stud shear connectors shall be placed adjacent to the point of dead load contraflexure in accordance with AASHTO Article 10.38.5.1.3. The number of studs provided per row in the negative moment portion shall equal the number per row provided in the positive moment portion.

SECTION 12 - SOIL-CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS

12.2 SERVICE LOAD DESIGN

Service Load Design shall be used as the standard design method for all structure types.

The use of the LRFD Bridge Design Specifications is permitted. The Manager, Structural Engineering shall concur to the use of these specifications.

SECTION 17 - SOIL- REINFORCED CONCRETE STRUCTURE INTERACTION SYSTEMS

17.1.4 DESIGN

Design shall be based on the working stress principles. An alternate design method may be used, subject to the approval of the Manager, Bureau of Structural Engineering.

The use of the LRFD Bridge Design Specifications is permitted. The Manager, Structural Engineering shall concur to the use of these specifications.

17.7 REINFORCED CONCRETE BOX, PRECAST

17.7.4.1 GENERAL REQUIREMENTS

Design shall conform to applicable sections of these specifications except as provided otherwise in this section and as modified by Subsection 1.30.4 of this Manual.

(NOTE: End reference to AASHTO Division 1 Section Number Designations)

1.3.2 OVERHEAD AND CANTILEVER SIGN SUPPORT STRUCTURES

The design shall be in accordance with the current AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, and the AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS.

For structural design criteria concerning Variable Message Sign (VMS) structures, refer to Section 32 of this Manual for guidance.

For additional information, see Sections 32 and 33 of this Manual.

1.3.3 PEDESTRIAN BRIDGES

(a) The AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES (with current Interims) shall govern with applicable modifications in accordance with Subsection 1.3.1 of this Manual. Also, refer to the NJDOT Pedestrian Compatible Planning and Design Guidelines for guidance and to the AASHTO Guide Specifications for Design of Pedestrian Bridges dated August, 1997.

(b) Live load for design shall be 4 kPa for area walkway.

(c) Vertical underclearances shall be as established in Subsection 1.3.1 of this Manual.

(d) Ramp type approaches together with auxiliary stairways shall be used. Ramps shall be 2.44 meters wide with a maximum grade of 8.33 percent. Stairway width shall be 1.8 meters, with 280 millimeter treads and 180 millimeter risers. Non-slip nosing shall be provided on stairs. Intermediate platforms shall be provided in all cases.

(e) Walkway width on the span(s) shall be 2.44 meters.

(f) Chain link fence (enclosed type) shall be provided on the portion of the bridge which spans the roadway, including shoulders. Use of chain link fence on ramps and/or stairways of the pedestrian bridges will be determined on a project to project basis. See Clearance Diagram on page 1.23-5.

(g) Members having simple or continuous spans shall be designed so that the deflection due to service live load shall not exceed 1/800 of the span length.

1.3.4 MOVABLE BRIDGES

(a) The design shall be in accordance with the AASHTO STANDARD

SPECIFICATIONS FOR MOVABLE HIGHWAY BRIDGES (with current Interims). (It is intended that these specifications be used in conjunction with the requirements of Subsection 1.3.1 of this Manual).

1.3.5 BIKEWAY BRIDGES

(a) The design shall be in accordance with the criteria established in Subsection 1.3.3 - PEDESTRIAN BRIDGES except that the bikeway width shall be 2.5 meters minimum.

(b) Reference is also directed to AASHTO GUIDE FOR DEVELOPMENT OF NEW BICYCLE FACILITIES for additional guidelines and clearance requirements. Also, refer to the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines for guidance.